

SECTION FOUR

ECONOMIC IMPACT ANALYSIS METHODOLOGY OVERVIEW AND COMPLIANCE COST ANALYSIS

This section covers several components necessary for identifying and characterizing the potential impacts of regulatory compliance costs of the Final Pharmaceutical Industry Effluent Guidelines at the facility and owner-company levels and other potential secondary impacts. Section 4.1 provides an overview of the methodology used in analyzing the economic impact of the regulatory compliance costs. Section 4.2 discusses the cost annualization model, which is the fundamental component of this methodology. Section 4.3 summarizes the results calculated using this model (i.e., the total annualized cost of compliance for the pharmaceutical industry as a whole for each of the regulatory options considered), and Section 4.4 presents the total costs of the Final Pharmaceutical Industry Effluent Guidelines and the MACT standards rule.

4.1 METHODOLOGY OVERVIEW

Together, the regulatory analyses presented in this EA offer a comprehensive assessment of economic impacts at all relevant levels of activity. Figure 4-1 shows how the three principal models used in the EA (the cost annualization model, the facility closure model, and the owner company model) relate to one another, the inputs required for these models, and the outputs they generate. At the heart of the EA is the cost annualization model, which uses facility-specific cost data and other inputs (from EPA's Development Document) to determine the annualized capital and operating and maintenance (O&M) costs of improved wastewater treatment. Annualized cost data feed into the facility analysis, which models the economic impacts of regulatory costs on pharmaceutical facilities, irrespective of ownership. The firm-level analysis examines the possible effects of increased regulatory costs on companies that own multiple affected pharmaceutical establishments and also gauges the ability of all firms to raise the capital necessary to purchase and install pollution control equipment. Firms might be able to cover the costs of pollution control, but be too weak financially to attract the capital to make the purchase. The EA then explores impacts on employment and other measures of community welfare. Additional analyses examine whether increased compliance costs will affect domestic or international markets, inflation, new sources, or small businesses.

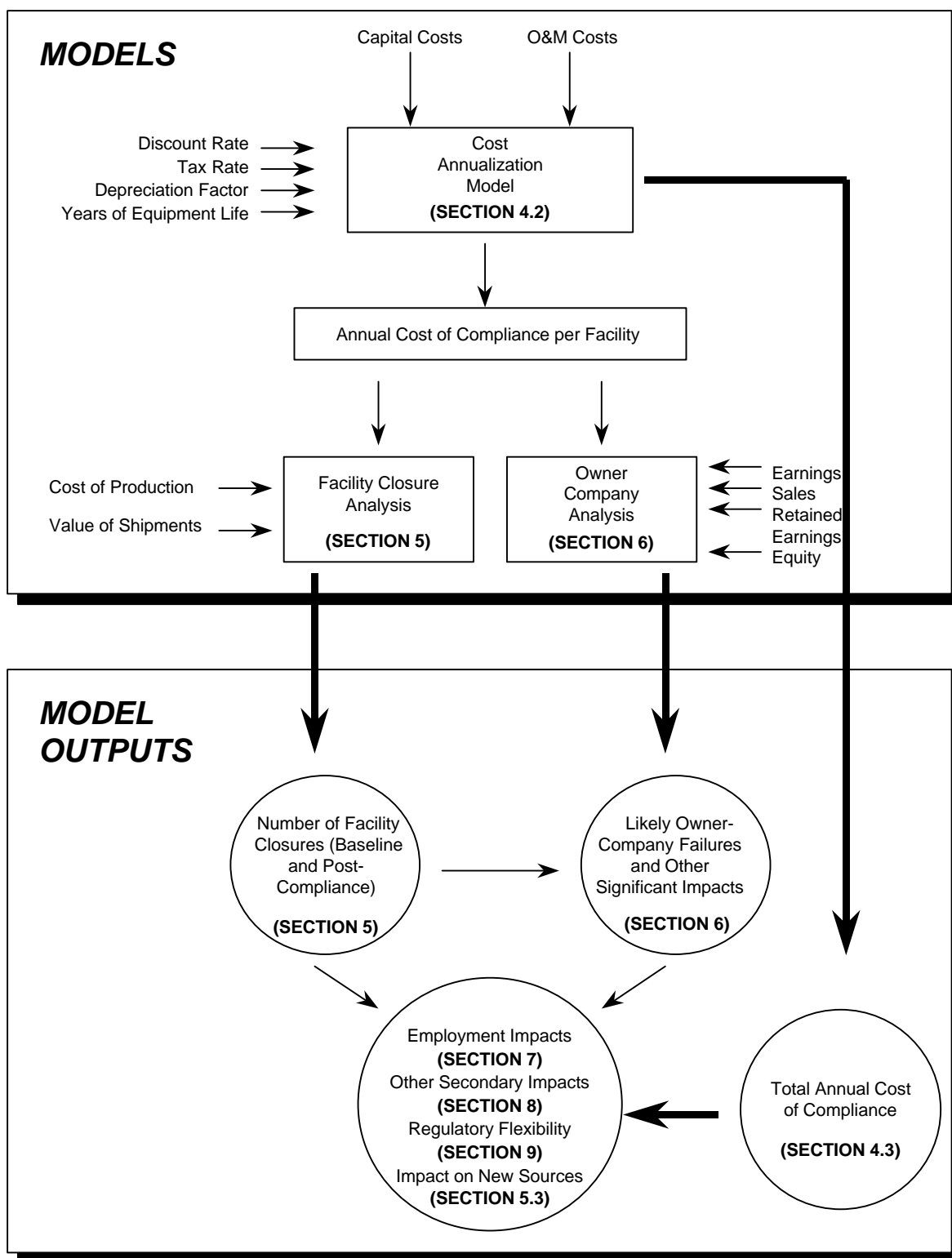


Figure 4-1. Interrelationship of EA methodology components.

4.2 COST ANNUALIZATION MODEL

4.2.1 Purpose of Cost Annualization

The cost annualization model estimates each facility's annual compliance cost on the basis of the costs required to purchase and operate new pollution control equipment for each Final Pharmaceutical Industry Effluent Guidelines option (or MACT standards cost). Cost annualization calculations consider the changes in annual cash outflow for each facility due to pollution control expenditures, once the tax effects of these expenditures (e.g., depreciation tax shields) are taken into account. Pollution control expenditures can be divided between two components: the initial capital investment to purchase and install the equipment and the annual cost of operating and maintaining such equipment (O&M costs). Capital costs are a one-time expense incurred only with the acquisition of the equipment, while O&M costs are incurred every year of the equipment's operation. The engineering cost model used to estimate facility compliance costs defines both capital and O&M costs.¹

To determine the economic feasibility of upgrading a facility, the costs of compliance must be compared to each facility's precompliance cash flow.² Pollution control costs cannot be directly compared to first-year facility cash flow, however; the capital costs must be annualized, reflecting the fact that capital equipment costs are incurred only once and can be financed (i.e., spread out over the equipment's lifetime).

In the model, EPA calculates total annualized costs by allocating the capital investment over the lifetime of the equipment, using a cost-of-capital factor to address the costs associated with raising or borrowing money for this investment, and adding in annual O&M costs. The resulting annualized cost

¹ Cost data are from EPA's Development Document.

² As will be discussed in Section Five, EPA did not have data to develop facilities' precompliance cash flow. EPA used a proxy for cash flow that is likely to be a conservatively low estimate of actual cash flow. See Section Five for more information.

represents the average annual payment a given company will need to make to upgrade its facility.³ EPA investigates in the firm-level analysis whether a firm can raise the capital to make the investment.

4.2.2 Inputs, Assumptions, and Model Outputs

4.2.2.1 Regulatory Options

The EA discusses a more limited set of options than is set forth in the Development Document. The options that are not discussed in the EA are primarily the no-action options (implicit in the baseline analyses discussed in Sections Five and Six), and a number of options that were rejected for reasons other than economic achievability. Discussions of why these options were rejected appear in the Development Document. Additionally, Best Conventional Control Technology (BCT) is not discussed here. The BCT cost test (the economic measure this regulation must meet) is undertaken in the Development Document.

The options that remain for discussion in the EA include:

- Best Practicable Control Technology (BPT), which is currently in place, but EPA is revising;
- Best Available Control Technology Economically Achievable (BAT), which has been developed assuming a revised BPT standard is in place;
- New Source Performance Standards, which are identical to the BAT options;
- Pretreatment Standards for Existing Sources (PSES);
- Pretreatment Standards for New Sources (PSNS), which include the same option as PSES.

³ The annualized cost is analogous to a mortgage payment, which spreads the one-time investment in a home into a series of continual monthly payments. An annualized cost approach also more closely reflects how companies report expenditures on pollution control equipment. This equipment must be capitalized, not expensed according to IRS requirements: The equipment can be depreciated, but the total cost of the equipment cannot be subtracted from income in the first year (Commerce Clearinghouse, Inc., 1995. *U.S. Master Tax Guide*, 1995; and Research Institute of America, Inc., 1995. *The Complete Internal Revenue Code* [Section 169]. New York, NY: Research Institute of America, Inc., January).

See Table 4-1 for a description of these options, an option name that corresponds with the option name used in the Development Document, and a shortened name that will be used in the EA.

EPA's selected options are as follows:

- A/C Directs: BPT-A/C and BAT-A/C; NSPS-A/C for new sources
- B/D Directs: BPT-B/D and the no-action BAT alternative (not shown in Table 4-1).
NSPS no-action alternative (not shown in Table 4-1) for new sources
- A/C Indirects: PSES-A/C; PSNS-A/C for new sources
- B/D Indirects: PSES-B/D; PSNS-B/D for new sources.

Note that the selected NSPS and PSNS options are identical to those selected for existing sources.

4.2.2.2 The Cost Annualization Model Parameters

Table 4-2 presents the cost annualization model using assumed data for illustrative purposes. The inputs and assumptions for the analysis are listed above the spreadsheet. The first input is the *facility code* for the facility analyzed. The second and third lines are the *facility type* (e.g., A/C) and discharge type (e.g., direct). The third line presents the regulatory *option* or alternative for which the annualized costs are calculated.⁴ The fourth and fifth lines are the option's *capital* and *O&M* costs (from EPA's Development Document). For comparison purposes, costs are provided in terms of 1990 dollars.

The *life of the asset* is determined according to the Internal Revenue Code's classes of depreciable property. Fifteen-year property is assumed to have a class life of 20 to 25 years—a typical life span for the equipment considered in the costing analysis. According to the U.S. Master Tax Guide, 15-year property includes such assets as municipal wastewater treatment plants.⁵ Thus, for the purposes of calculating depreciation, most components of the capital cost for a pollution control option would be considered 15-year property.

⁴ The terms "option" and "alternative" are used interchangeably in this section.

⁵ Commerce Clearinghouse, Inc., 1995. *U.S. Master Tax Guide*. p. 322.

Table 4-1

Summary of Regulatory Options Considered In Economic Analysis^a

Regulation	Short Option Description for EA Only	Option	Type of Treatment
BPT	BPT-A/C	Revise COD and modify cyanide	Advanced biological treatment
	BPT-B/D	Revise COD and withdraw cyanide	Advanced biological treatment
BAT	BAT-A/C	Add organics, ammonia, and COD and modify cyanide	Advanced biological treatment with nitrification
	BAT-B/D	Add COD and withdraw cyanide	Advanced biological treatment
NSPS	NSPS-A/C	Promulgated level of BPT/BAT control	Advanced biological treatment with nitrification
	NSPS-B/D	Promulgated level of BPT/BAT control	Advanced biological treatment
PSES	PSES-A/C	Add organics, ammonia, and modify cyanide	In-plant steam stripping for organic compounds and ammonia
	PSES-B/D	Add organics and withdraw cyanide	In-plant steam stripping for organic compounds
PSNS	PSNS-A/C	Add organics, ammonia, and modify cyanide	In-plant steam stripping for organic compounds and ammonia
	PSNS-B/D	Add organics and withdraw cyanide	In-plant steam stripping for organic compounds

^a Many other options were considered and rejected for reasons other than economic achievability. See EPA's Development Document. Also, no-action options are included for all regulations. BCT is not analyzed in the EA. See the Development Document.

Source: U.S. EPA, 1998. *Technical Development Document for Effluent Limitations Guidelines and Standards for the Pharmaceutical Manufacturing Point Source Category.*

Table 4-2

Sample Spreadsheet for Annualizing Costs

Inputs							
Facility Code:	30387						
Facility Type:	A/C						
Discharge Type:	Direct						
Option:	BAT						
Initial Capital Cost (\$) (Line A):	\$614,487						
Annual Operation & Maintenance Cost (\$) (Line B):	\$58,710						
Life of Asset (yrs.)	15						
Real Discount Rate:	7.0%						
Marginal Income Tax Rates:							
Federal	34.00%						
State	6.75%						
Combined (Line C)	38.46%						
1	2	3	4	5	6	7	8
Year	Depreciation Rate	Depreciation For Year (Line A *Col 2)	Tax Shield From Depreciation (Line C *Col 3)	O&M Cost (Line B)	O&M Tax Shield (Line C *Col 5)	Cash Outflow (Line A in Yr 1; Line B in Yrs 2-16)	Cash Outflow After Tax Shields (Col 7-(Col 6+Col 4))
1	0.000%	\$0	\$0	\$0	\$0	\$614,487	\$614,487
2	10.000%	\$61,449	\$23,630	\$58,710	\$22,577	\$58,710	\$12,503
3	9.643%	\$59,254	\$22,786	\$58,710	\$22,577	\$58,710	\$13,347
4	9.272%	\$56,975	\$21,910	\$58,710	\$22,577	\$58,710	\$14,223
5	8.886%	\$54,601	\$20,997	\$58,710	\$22,577	\$58,710	\$15,136
6	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
7	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
8	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
9	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
10	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
11	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
12	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
13	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
14	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
15	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
16	5.655%	\$34,746	\$13,362	\$58,710	\$22,577	\$58,710	\$22,771
Sum	100.00%	\$614,487	\$236,301	\$880,650	\$338,654	\$1,495,137	\$920,182
Present Value[a]		\$396,120	\$152,328	\$534,726	\$205,629	\$1,149,213	\$791,256
Present Value of Incremental Costs (Present Value of Col 8):			\$791,256				
Annualized Cost [a]:			\$83,761				

Note: Spreadsheet assumes that a modified accelerated cost recovery system (MACRS) is used to depreciate capital expenditures (see text).

[a] See Figure 4-2 for formulas.

Source: See Appendix A.

The *discount rate*, which reflects the costs of capital for pharmaceutical facilities and is used to calculate the present value of the cash flows, is based on the real cost of capital of 7 percent recommended by OMB.⁶

The final model parameters are the federal and average state *tax rates*, which are used in determining each facility's tax benefit or tax shield. A facility is allowed to reduce its taxable income by the amount spent on incremental O&M costs and by the depreciable portion of its capital equipment.⁷ The tax rate used in the model is the marginal federal tax rate of 34% and the average state corporate income tax rate (see Appendix A). The average state tax rate is used in the cost annualization model because it can be unclear which state tax rates apply to a given facility's revenues. For example, a facility located in one state might be owned by a firm whose corporate headquarters is located in a second state and whose corporate holding company is located in a third.

4.2.2.3 The Cost Annualization Model Structure and Outputs

Two assumptions were made in annualizing compliance costs. The first assumption is that the facility owners will be using the Modified Accelerated Cost Recovery System (MACRS) to depreciate capital investments, which reduces the effective cost to the facility of purchasing and operating the pollution control equipment. The second is that a 1-year delay occurs between the purchase of pollution control equipment and its operation. The details of these assumptions and their impact on the results of the MACRS cost annualization model are presented in Appendix A.

In Table 4-2, the spreadsheet contains numbered columns in which the costs of the investment to the facility are calculated. The first column lists each year of the equipment's life span, from its

⁶ OMB, 1996. *Economic Analysis of Federal Regulations under Executive Order 12866*. January 11.

⁷ Commerce Clearinghouse, Inc., 1995. *U.S. Master Tax Guide*. p 314.

installation through its 15-year depreciable lifetime.⁸ Column 2 represents the portion of capital costs that can be written off or depreciated each year; these rates are based on MACRS, as shown in Appendix B. By multiplying these rates by the total capital cost, EPA calculates the annual amount the facility can depreciate (Column 3). These depreciable amounts are used by the firm to offset annual taxable income. Column 4 shows the tax benefit provided by the depreciation expense, (i.e., the overall tax rate times the depreciation amount for the year).

Column 5 of Table 4-2 shows the annual O&M expense. These costs are constant, except in Year 1 when no O&M costs are incurred because the equipment is not in service in this year. Column 6 shows the tax shield or benefit provided from expensing the O&M costs. Column 7 lists the facility's total expenses associated with the additional pollution control equipment: EPA assumes that capital costs are incurred during the first year when the equipment is installed. The O&M expense is added to capital costs for all years except Year 1. Column 8 lists the annual cash outflow minus the tax shields from the O&M expenses and depreciation because the facility will recoup these costs as a result of reduced income taxes.

Once the yearly cost to the facility has been determined, the yearly cost is transformed into a constant cost stream. The bottom line in Column 8 represents the present value of the costs over the equipment's life span. The annualized cost is calculated as the 16-year annuity (15 years plus one year) that has the same present value as the bottom line in Column 8 of Table 4-2. The annualized cost represents the annual payment required to finance the capital outlay and pay for O&M after tax shields. In essence, paying the annualized cost every year and paying the amounts listed in Column 8 for each year are equivalent. In this example, the capital investment of \$614 thousand and annual O&M cost of \$59 thousand (1990 dollars) result in an annualized posttax cost of \$101 thousand.⁹ Figure 4-2 presents the equations used to calculate present value and annual cost.

⁸ An asset's depreciable life can differ from its actual life. The pollution control equipment considered in this analysis is in the 15-year property class; however, the actual life could extend to 25 years. EPA's estimate of annualized costs is conservatively high as long as the equipment does not have to be replaced in its entirety (costs for replacement pumps and other equipment needed for maintenance have been included in O&M) in less than 16 years (see Appendix A).

⁹ Note that the annualized cost can be determined in two ways. The first way is to calculate the annualized cost as the difference between the annuity value of the cash flows (Column 7) and the tax shields (Columns 4 and 6). The second way is to calculate the annuity value of the cash flows after tax shields (Column 8). Both methods yield the same value.

$$\text{NET PRESENT VALUE} = v_1 + \sum_{i=2}^n \frac{v_i}{(1 + \text{int})^{i-1}}$$

where:

$v_1 \dots v_n$ = series of cash flows
 int = interest rate
 n = number of cash flow periods
 i = current iteration

$$\text{ANNUALIZED PAYMENT} = \text{principle} \times \frac{\text{int}}{1 - (\text{int} + 1)^{-n}}$$

where:

int = periodic interest rate
 n = term

Figure 4-2. Calculations used to compute present value.

The present value of the cost for incremental pollution control is used in the facility analysis as a proxy for the change in facility earnings. The present value of O&M plus the present value of depreciation are used in Section Six as the change in earnings before interest and taxes (EBIT), which is needed to estimate the impacts on firms (Section Five). Results of the calculation of aggregate compliance costs are presented below in Section 4.2.

4.3 TOTAL ANNUALIZED COMPLIANCE COSTS

EPA calculates total annualized compliance costs by aggregating the annualized compliance costs for all affected facilities, based on the output of the cost annualization model. Table 4-3 presents the results of this cost aggregation by regulatory option. Impacts on firms and facilities, which are discussed in other sections of this report, are calculated on the basis of these posttax costs (i.e., the costs as perceived by the affected firms and facilities after taxes are paid).

As Table 4-3 shows, costs of all options range from \$0.2 million to \$23.4 million, with the selected options ranging from \$0.7 million (for B/D direct; cost of BPT only) to \$23.4 million for A/C indirects. Each subcategory also has a no-action option. These no-action options are not presented here, because they are associated with zero costs. Average costs per facility range from \$31,000 to \$266,000 among the selected options. Total costs of all selected options are \$32.0 million.

4.4 COSTS OF THE PHARMACEUTICAL EFFLUENT GUIDELINES WITH MACT STANDARDS COSTS INCLUDED

Table 4-4 presents the sum of the selected options, as well as compliance costs for MACT standards requirements (which are annualized using the same model and assumptions described in Section 4.3). As the table shows, the total cost of the selected options for the Final Pharmaceutical Effluent Guidelines is \$32.0 million (\$1990). With MACT standards wastewater emission control costs included (see Section Two and Appendix B), the water-related cost of the two rules is \$37.8 million (\$1990). Total cost of both rules together (for facilities in the effluent guidelines analysis only) is \$58.3 million (\$1990). Total cost of both

Table 4-3

**Annualized Posttax Costs of Compliance with Final Pharmaceutical Industry Effluent Guidelines
(1990 dollars)**

Option *	Capital Costs	O&M Costs	Annualized Compliance Costs	Facilities Incurring Costs **	Average Costs per Facility ***
Direct Discharge					
BPT-A/C	\$2,422,402	\$1,825,253	\$1,275,930	24	\$53,164
BPT-B/D	\$1,785,772	\$966,864	\$715,893	14	\$51,135
BAT-A/C	\$5,569,135	\$2,423,726	\$1,881,579	24	\$78,399
Indirect Discharge					
PSES-A/C	\$80,864,749	\$28,597,244	\$23,407,105	88	\$265,990
PSES-B/D	\$22,067,126	\$5,010,342	\$4,729,914	153	\$30,914
All Facilities					
Total Selected Options	\$112,709,184	\$38,823,429	\$32,010,421	279	\$114,733

* All subcategories have a no-action option; the no-action options are not presented here, since costs for those options are zero.

** The total number of facilities incurring costs includes all facilities except for seven zero discharge facilities.

*** Over number of facilities that incur costs.

Table 4-4
Cost of Selected Options and MACT Standards Costs
(1990 dollars)

Cost Category	Capital Costs	O&M Costs	Annualized Compliance Costs	Facilities Incurring Costs *	Average Costs per Facility **
Selected effluent guidelines option costs	\$112,709,184	\$38,823,429	\$32,010,421	279	\$114,733
MACT standards costs (wastewater emission controls)	\$30,907,772	\$5,644,605	\$5,810,120	20	\$290,506
Total MACT for effluent guidelines analysis	\$102,822,547	\$30,535,434	\$26,305,357	71	\$370,498
Total MACT standards costs, all facilities	\$120,263,588	\$36,007,268	\$30,940,806	NA	NA
Selected effluent guidelines options and MACT standards wastewater costs	\$143,616,956	\$44,468,034	\$37,820,541	279	\$135,557
Selected effluent guidelines options and MACT standards total costs (effluent guidelines facilities only)	\$215,531,731	\$69,358,862	\$58,315,778	279	\$209,017
Selected effluent guidelines options and MACT standards total costs (all facilities) ***	\$232,972,772	\$74,830,697	\$62,951,227	NA	NA

* The total number of facilities incurring costs includes all facilities except for seven zero discharge facilities.

** Over facilities that incur costs.

*** Total includes MACT standards costs for some facilities not in the effluent guidelines analysis; the average is calculated only over facilities in the effluent guidelines analysis.

rules, including MACT standards costs for facilities not covered by the Final Pharmaceutical Industry Effluent Guidelines, is \$63.0 million (\$1990).